

# Fathers' alcohol use and suicidal behaviour in offspring during youth and young adulthood

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**Objective:** To examine the association between various indicators of father's alcohol use and suicidal behaviour in offspring during youth and young adulthood.

**Methods:** The study is based on a cohort of 68 910 Swedish citizens who were born between 1970 and 1985 and have fathers who participated in conscription for compulsory military training in 1969/70. Information on fathers' alcohol use was collected during conscription. Offspring was followed for suicide attempts or completed suicides (through linkage with national registers) from age 12 to end of follow-up in 2008.

**Results:** After adjustment for confounders, the hazard ratio (HR) for offspring to fathers who were heavy drinkers was 1.4 (95% CI 1.02, 1.93) while the associations turned non-significant for offspring to fathers who often drank into intoxication, HR 1.14 (0.68, 1.90). The highest risk for suicidal behaviour was found for offspring to fathers who had been apprehended for drunkenness two times or more, or with an alcohol-related hospitalization, with adjusted HRs of 2.1 (1.4, 3.14) and 1.9 (1.27, 2.85) respectively.

**Conclusion:** Fathers' alcohol use is associated with increased risk of suicidal behaviour among offspring in youth and young adulthood.

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Key words: Fathers' alcohol use; offspring suicidal behaviour; youth and young adulthood; cohort study

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## Significant outcomes

- The highest risk for suicidal behaviour was found for offspring to fathers with the most problematic consumption, that is having been apprehended for drunkenness or with an diagnosed alcohol-related disorder.
- Offspring to fathers drinking heavily, but without alcohol-related disorders, were also of increased risk for suicidal behaviour.
- Most indicators of fathers' alcohol use had an effect over and above other predictors of suicidal behaviour in offspring that tend to co-occur with parental heavy drinking.

## Limitations

- The self-reported indicators of fathers' alcohol use were measured in fathers' youth and do not measure actual exposure to parental drinking during the offspring childhood, but rather whether fathers' alcohol use in youth translates into risk for suicide in offspring.
- We had no self-reported information on maternal alcohol use.

## Introduction

A large body of research has established a link between harmful alcohol use and suicidal behaviour (1, 2). The association is particularly apparent among adolescents, where heavy drinking or frequently drinking into intoxication has been found to be associated with both suicidal ideations (3), suicide attempts (4, 5) and completed suicides (6, 7). The vast majority of studies have focused on the risk of suicidal behaviour in the drinker him/herself (8). However, within alcohol epidemiology, it has become increasingly recognized also to assess how alcohol use may negatively affect those in the environment of the drinker, referred to as alcohol's harm to others (9). From this perspective, it is essential to study the effect that harmful levels and patterns of drinking may have on the risk of suicidal behaviour on other family members and, more specifically, the association between parental drinking and suicide attempts in offspring – which is the focus of the present study.

To date, few studies have examined the relationship between alcohol use among parents and risk of suicidal behaviour in offspring. One line of research has focused on children of parents with more severe, long-term alcohol problems. For instance, Alonzo et al. (10) found that parental alcohol abuse increased the risk of lifetime suicide attempts in offspring in a sample from the 2001–2002 US NESARC study. Moreover, Fergusson et al. (11) studied a birth-cohort of 1256 children from New Zealand and found that offspring to parents with serious alcohol problems had a two-fold risk of suicide attempts between the ages of 15 and 21 years. Only a handful of studies have assessed how consumption among parents without severe alcohol problems is associated with suicidal behaviour in offspring. Rossow and Moan (8) studied two large Norwegian school surveys and found that suicidal behaviour among adolescents had a positive relationship with the frequency of parental intoxication (reported by offspring), which was significant already for offspring with parents who drank into intoxication only sometimes per month. Similarly, Grøholt et al. (12) found that having parents that drank into intoxication sometimes per month or more often was related to increased risk suicide attempts in a case-control study of Norwegian adolescents. Finally, based on a national cohort of Swedish men, we studied the relationship between fathers' frequency of drinking and long-term risk for completed suicide in sons (13). Our results revealed an increased risk of suicide among sons whose fathers drank often, but the relationship was fully explained after

adjustment by factors related to parental drinking and adverse childhood psychosocial circumstances.

While most studies find a significant link between parental drinking and suicidal behaviour in offspring, they tend to suffer from limitations that impair their generalizability and/or ability to establish causality. For instance, studies that include larger representative samples typically have cross-sectional study designs (8, 10, 12). On the other hand, most prospective studies are based on small community samples (11, 14), high-risk clinical samples of suicidal youths (15), or offspring to parents with diagnosed mental disorders (16, 17). Moreover, while most studies include adjustment for sociodemographics and various parental factors related with suicidal behaviour in offspring, they tend to have insufficient control for relevant confounders and mediators. Taken together, this implies that there is little knowledge concerning: (i) the degree to which it is the parental alcohol consumption *per se* that increases the risk of suicidal behaviour in offspring, or whether the relationship is explained by other, unmeasured factors, and (ii) what pathways and mechanism link parental drinking to suicide attempts in offspring.

Several such pathways and mechanisms could be hypothesized. First, there may occur a direct transmission of parental heavy drinking to offspring through, for example social learning, specific ways of communicating about alcohol and/or favourable attitudes towards alcohol use (18–20). In line with this, studies have found that alcohol use among children accounts for some of the observed association between parental alcohol use and suicidal behaviour in offspring (8, 13). Second, problem drinking may impair parental/family functioning and negatively affect the child's mental health and personality (21–23), or result in adverse childhood experiences (24–26), which all are associated with increased risk of suicidal behaviour in offspring (5, 7, 11, 27). In these first two cases, the relationship between parental drinking and offspring suicidal behaviour would be mediated by factors closely related to parental drinking. Third, heavy drinking in parents tends to co-occur with other environmental and family factors that are associated with increased risk of suicide attempts in offspring, including low socioeconomic position (SEP) (11, 12) and parental impulsivity (28), mental disorders (7, 29) and suicidal behaviour (5, 29, 30). In this case, the relationship between parental drinking and suicidal behaviour in offspring may partly be spurious, and it is thus essential to control for these possibly confounding risk factors. Finally, a part of the relationship is plausibly due to hereditary transmission of suicidal behaviour (30, 31),

heavy drinking (32) and other risk factors for suicidality (31).

### Aim of the study

In the present study, we aim to investigate the association between fathers' alcohol consumption and risk for suicidal behaviour (defined as suicide attempts and completed suicides) in offspring during youth and young adulthood. To overcome the limitations of previous research, this study is based on a unique prospective cohort design that combines survey information from a full cohort of Swedish men (fathers) born around 1950, with registry data on suicide attempts and completed suicides in their offspring. More specifically, we will assess how different dimensions of fathers' alcohol use (average volume of consumption, frequency of drinking into intoxication, having been apprehended for drunkenness and alcohol-related disorders) are related to suicide attempts and completed suicides in offspring from age 12 to age 39. To further strengthen our approach, we analyse to what degree the relationship is affected by other risk factors for suicidal behaviour in offspring that tend to co-occur with parental heavy drinking, including low childhood socioeconomic position (SEP), fathers' emotional control and psychiatric diagnoses as well as parental (both mothers' and fathers') hospitalizations due to suicide attempts, drug-related disorders, and mood or stress disorders.

## Material and methods

### Data collection

Figure 1 shows a timeline of the cohort, including timing of surveys and record linkages. The study population comprises a cohort of 68 910 Swedish citizens who were born between 1970 and 1985 (those born after 1985 was excluded from the study, in order to obtain a sufficient follow-up time) and have fathers who participated in conscription for compulsory military training in 1969/70. Only 2–3% of all Swedish men were exempted from conscription at that time, in most cases due to severe handicaps or congenital disorders. Only fathers born in 1949–1951 were included in this study, accounting for 97.7% of all conscripts in 1969/1970.

During conscription, the men (fathers) were asked to complete two questionnaires. The first contained questions about social background, behaviour and adjustment, psychological factors, health, etc. The second contained questions that dealt specifically with substance use, for example alcohol consumption and tobacco smoking. All

men also went through a health examination and met with a physician who diagnosed any disorders according to the Swedish version of International Classification of Disease (ICD), eighth revision (ICD-8). They also met a psychologist for a structured interview.

### Outcomes

The offspring were followed for hospitalizations due to suicide attempts, or suicide mortality, from age 12 to the end of follow-up in 2008 (up to age 39). Information on suicide attempts and on suicide mortality, between 1982 and 2008, was obtained by record linkage with the National Hospital Discharge Register and the National Cause of Death Register, respectively, and included the following ICD codes: ICD-8/9: E950–E959, E980–E989; ICD-10: X60–X84, Y10–Y34.

### Exposure: Fathers' alcohol consumption

Information on fathers' alcohol use was obtained from the conscription examination and included the following three variables. 1. *Volume of consumption* measured by a beverage-specific quantity–frequency scale that was summed into grams of 100% alcohol per week and then coded into consumption quintiles plus abstainers (see Table 1 for the volume ranges of each quintile). 2. *Frequency of intoxication* measured by the question 'How often do you drink until you feel intoxicated?' and coded into the five categories: abstainers, drinkers never drinking into intoxication, sometimes, fairly often and often. 3. *Apprehended for drunkenness* measured by the question 'Have you ever been apprehended for drunkenness?' and coded into abstainers, drinkers never apprehended, apprehended once and apprehended two times or more. In addition, we included the exposure variable *alcohol-related disorder* by identifying offspring with fathers who had obtained alcohol-related diagnoses in the National Hospital Discharge Register from 1973 up to offspring's 12th birthday. The ICD codes included: ICD-8: 291, 303, 571.00, 571.01, 980; ICD-9: 291, 303, 305A, 357F, 425F, 535D, 570.0, 570.1, 571A–D, 790D, 980; ICD-10: E244, F10, G312, G621, G721, I426, K292, K70, K852, K864–7, O354, T51, X45, X65, Z502, Z714, Z721, Y90, Y91. A correlation matrix including the indicators of fathers alcohol use is shown in a supplementary table (Table S1). The correlations were somewhat stronger (around 0.6) between volume of consumption and frequency of intoxication on the one hand, and apprehended for drunkenness and alcohol-related disorder on the

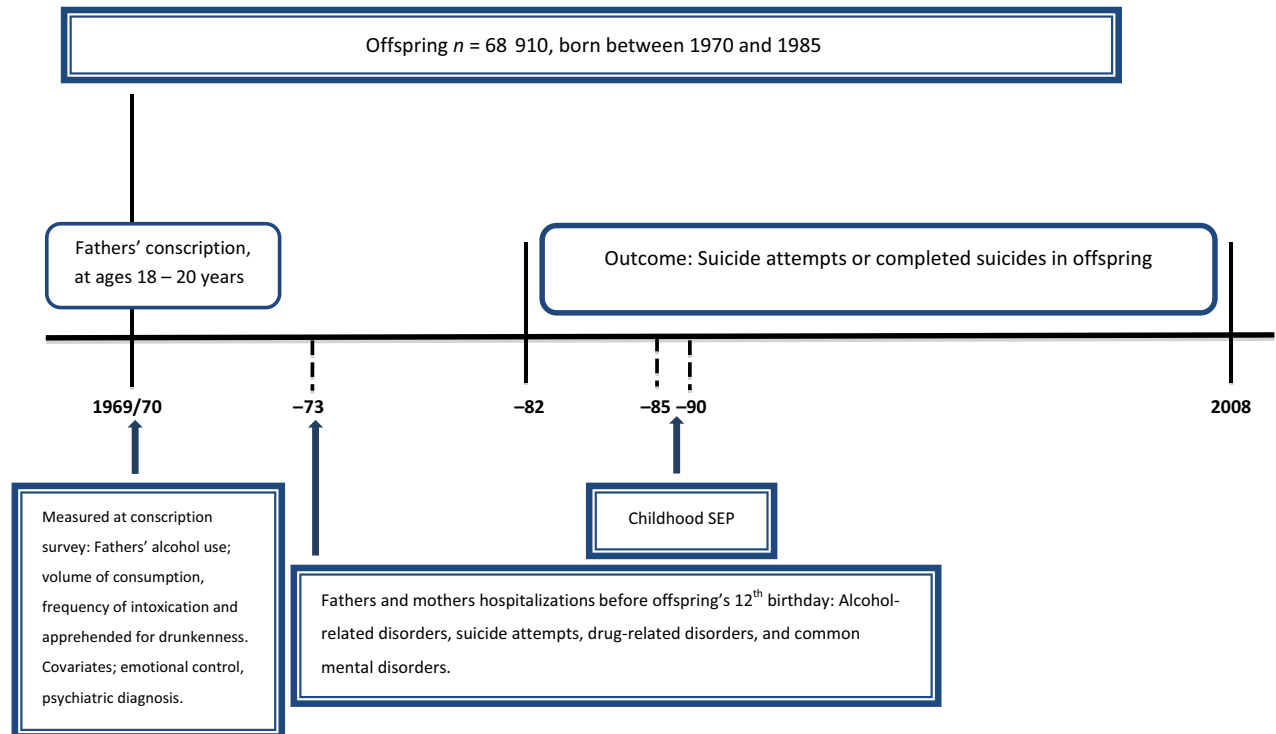


Fig. 1. Timeline showing cohort, timing of surveys and record linkages. The cohort consisted of 68 910 Swedish citizens who were born between 1970 and 1985 and have fathers who participated in conscription for compulsory military training in 1969/70, at ages 18 to 20 years. [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

other. The remaining correlations were weak to moderate (around 0.4).

#### Covariates

As covariates, we included a number of risk factors for suicide in offspring that tend to co-occur with parental heavy drinking. Our view is that these risk factors most likely are confounders in the association between fathers' alcohol consumption and later risk of suicidal behaviour in offspring. Information on two covariates was obtained from the fathers at the conscription examination: '*Poor emotional control*' (rated by psychologist as suffering from reduced functions due to psychosomatic symptoms, low tolerance to stress and/or anxiety, problems controlling nervousness and aggression, and incapacity for emotional commitment, corresponding to the lowest 30% in a Gaussian distribution of general emotional control) and receiving a *psychiatric diagnosis* from a psychiatrist.

Information on childhood SEP was retrieved from the 1985 census (for offspring born between 1970 and 1975) and 1990 census (for offspring born between 1976 and 1985) and measured as fathers' occupational class, categorized into six groups according to the Swedish socioeconomic classification of occupations: unskilled workers, skilled

workers, low-level non-manual employees, intermediate non-manual employees, high-level non-manual employees and self-employed.

Information on hospitalizations due to mental disorders among mothers and fathers from 1973 up to offspring's 12th birthday was obtained from the National Hospital Discharge Register and coded into four categories of diagnoses: *Suicide attempts* (including the same ICD codes as for the offspring); *Alcohol-related disorders* (including the same ICD codes as for fathers alcohol-related diagnoses); *Drug-related disorders* (ICD-8: 304, 965, 967.0, 970.0, 971; ICD-9: 304, 305X, 965A, 967A 969G, 969H, 969X; ICD-10: F11-F16, F18, F19, T40, T43.6); and *Common mental disorders*, including affective disorders (mood disorders) (ICD-8: 296, 300.4; ICD-9: 296, 311; ICD-10: F30-F39) and nervous or stress-related disorders (ICD-8: 300, 305, 307; ICD-9: 300, 306, 308, 309; ICD-10: F40-F48).

#### Statistical analyses

Cox proportional-hazards regression was used for the analyses of associations between the indicators of fathers' alcohol consumption and suicidal behaviour in offspring. The follow-up for suicidal behaviour was set between 1982 and 2008, and

## Fathers' alcohol use and offspring suicidal behaviour

Table 1. Distribution of number of offspring, suicidal behaviour and covariates, across categories of fathers' alcohol consumption (in volume quintiles)

Quintile Volume range	Fathers' alcohol consumption in volume quintiles + abstainers												Total	
	Abstainers 0 g		1>0–12 g		2>12–30 g		3>30–53 g		4>53–96 g		5>96 g			
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Number of offspring	3481	5.4	12 218	18.9	12 273	19.0	12 341	19.1	12 410	19.1	11 996	18.5	64 719	100
Suicidal behaviour	45	1.3	184	1.5	192	1.6	214	1.7	226	1.8	295	2.5	1156	1.8
Low childhood SEP*	533	15.3	2172	17.8	2142	17.5	2023	16.4	2173	17.5	2353	19.6	11 396	17.6
Fathers' risk factors at conscription†														
Psychiatric diagnosis	375	10.8	993	8.1	1013	8.3	965	7.8	1134	9.1	2272	18.9	6752	10.4
Low emotional control	921	26.5	2952	24.2	2893	23.6	2948	23.9	3363	27.1	4848	40.4	17 925	27.7
Parental mental disorders‡														
Common mental disorders	130	3.7	473	3.9	416	3.4	503	4.1	510	4.1	708	5.9	2740	4.2
Suicide attempts	36	1.0	194	1.6	213	1.7	253	2.1	308	2.5	506	4.2	1.51	2.3
Alcohol-related disorders	24	0.7	203	1.7	210	1.7	290	2.4	358	2.9	678	5.7	1763	2.7
Drug-related disorders	16	0.5	87	0.7	90	0.7	109	0.9	113	0.9	264	2.2	679	1.1

\*Measured in the 1985 or 1990 census.

†Measured in fathers at age 18.

‡Measured as parental hospitalizations before offspring's 12th birthday.

person-time was calculated from the offspring's 12th birthday until date of suicide attempt, completed suicide, death, emigration or end of follow-up, whichever came first. Offspring who emigrated were censored on the day of first emigration regardless of any re-migration during follow-up. Associations were estimated by hazard ratios (HRs), with 95% confidence intervals, using the stcox procedure (Cox proportional-hazards regression) in the STATA 15 SE program. We used the vce (cluster) option in order to account for the offspring being clustered on the fathers. This option relaxes the requirement of independent observations, by producing standard errors that assume independence across clusters (fathers), but allow for intragroup correlation (between offspring) within clusters. All results are based on those 64 719 offspring (94%) for whom there was information on all the variables included in the final analyses.

We tested for interaction between offspring sex and fathers' alcohol use on the risk for suicidal behaviour in offspring, by fitting models that included interaction terms between offspring sex and each of the alcohol use variables. No significant interaction was detected, and our main analyses were therefore performed for male and female offspring combined.

First, we estimated crude models of the associations between the father's alcohol consumption and suicidal behaviour in offspring. Second, we examined the attenuation of these associations after adding the covariates in the following separate models: childhood SEP, fathers' risk factors at conscription (emotional control and psychiatric diagnosis) and parental mental disorders (mood/stress, suicide attempts and drug-related

disorders). Finally, all covariates were entered concurrently in a fully adjusted model. In order to assess whether fathers' alcohol use has an association with suicidal behaviour also among offspring to parents without diagnosed alcohol-related disorders, we replicated the fully adjusted models after exclusion of fathers with alcohol-related hospitalizations before follow-up.

We performed four sensitivity analyses. First, we wanted to assess whether the effect of fathers alcohol use differed between suicide attempts and completed suicides in offspring. However, as the number of suicides was quite low ( $n = 118$ ), there was only sufficient power to assess suicide attempts ( $n = 1062$ ) separately. Consequently, we replicated the analyses including only suicide attempts as outcome. Second, we tested a model with an exposure variable that represented the interaction of fathers and mothers' alcohol-related disorders. Third, in order to assess whether the associations are mediated by offspring heavy alcohol use, we fitted models that adjusted for alcohol-related hospitalizations in offspring ( $n = 1312$ ), excluding those hospitalizations occurring after suicide attempts ( $n = 95$ ). Finally, we replicated the fully adjusted models after excluding offspring with divorced fathers ( $n = 4047$ , information retrieved from the 1985 census).

## Results

### Descriptives

Tables 1–3 show how the offspring, their suicidal behaviour and covariates are distributed across the categories for each of the indicators of fathers' alcohol consumption. With regard to more

problematic parental drinking, nearly 12.3% of all offspring had fathers who drank into intoxication quite often or often (Table 2) and 7.8% had fathers who had been apprehended for drunkenness at least once (Table 3). The prevalence of suicidal behaviour among offspring (Table 1) amounted to 1.8% (1156 cases) and increased across the categories within all indicators of fathers' alcohol use. Similarly, all covariates showed a positive association with the indicators of fathers' consumption. Compared to offspring with abstaining fathers, offspring of fathers who were in the highest drinking quintile, who drank into intoxication often or who had been apprehended for drunkenness two times or more were more likely to have: low childhood SEP, fathers with psychiatric diagnoses or low emotional control (at conscription) and parents with hospitalizations due to suicide attempts, drug-related disorders and common mental disorders (all  $P < 0.001$ ,  $\chi^2$ , not shown in table).

The relationship between the indicators of fathers' alcohol consumption and suicidal behaviour in offspring

All indicators of fathers' alcohol consumption had a positive and significant effect on the risk of suicidal behaviour in offspring (Table 4). In the crude models, the risk for suicidal behaviour in offspring increased stepwise across the categories of the indicators of fathers' volume of consumption and frequency of intoxication – however, with only the highest volume quintile being fully significant. Offspring to fathers who were in the highest consumption quintile (1.83 [95% CI 1.33, 2.52], who often drank into intoxication (2.06 [95% CI 1.27, 3.35]) or who had been apprehended for drunkenness

Table 3. Distribution of number of offspring, suicidal behaviour and covariates, across categories of fathers' alcohol consumption (having been apprehended for drunkenness)

	Father having been apprehended for drunkenness							
	Abstainers		Drinkers never apprehended		Once		Twice or more	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Number of offspring	3481	5.4	56 167	86.8	3899	6.0	1172	1.8
Suicidal behaviour	45	1.3	941	1.7	103	2.6	67	5.7
Low childhood SEP*	533	15.3	9690	17.3	887	22.8	286	24.4
Fathers' risk factors at conscription†								
Psychiatric diagnosis	375	10.8	5100	9.1	743	19.1	534	45.6
Low emotional control	921	26.5	14 687	26.2	1536	39.4	781	66.6
Parental mental disorders‡								
Common mental disorders	130	3.7	2211	3.9	267	6.9	132	11.3
Suicide attempts	36	1.0	1136	2.0	205	5.3	133	11.4
Alcohol-related disorders	24	0.7	1188	2.1	313	8.0	238	20.3
Drug-related disorders	16	0.5	462	0.8	100	2.6	101	8.6

\*Measured in the 1985 or 1990 census.

†Measured in fathers at age 18.

‡Measured as parental hospitalizations before offspring's 12<sup>th</sup> birthday.

once (1.93 [95% CI 1.35, 2.77]) had an approximately two-fold risk of suicidal behaviour during follow-up compared to offspring with abstaining fathers. Moreover, offspring to fathers who had been apprehended for drunkenness two times or more (4.20 [95% CI 2.86, 6.17]), or with an alcohol-related disorder (4.47 [95% CI 3.11, 6.43]), had a more than four-fold risk of suicidal behaviour relative to offspring with abstaining fathers.

Table 2. Distribution of number of offspring, suicidal behaviour and covariates, across fathers' frequency of drinking into intoxication

	Fathers' frequency of drinking into intoxication									
	Abstainers		Drinkers never intox.		Sometimes		Quite often		Often	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Number of offspring	3481	5.4	7289	11.3	45 086	69.7	7950	12.3	913	1.4
Suicidal behaviour	45	1.3	103	1.4	827	1.83	156	2.0	25	2.7
Low childhood SEP*	533	15.3	1217	16.7	7901	17.5	1534	19.3	211	23.1
Fathers' risk factors at conscription†										
Psychiatric diagnosis	375	10.8	669	9.2	4063	9.0	1295	16.3	350	38.3
Low emotional control	921	26.5	1792	24.6	11 596	25.7	3039	38.2	577	63.5
Parental mental disorders‡										
Common mental disorders	130	3.7	307	4.2	1849	4.1	391	4.9	63	6.9
Suicide attempts	36	1.0	118	1.6	1050	2.3	246	3.1	60	6.6
Alcohol-related disorders	24	0.7	131	1.8	1183	3	345	4.3	80	8.8
Drug-related disorders	16	0.5	46	0.6	442	1.0	127	1.6	48	5.3

\*Measured in the 1985 or 1990 census.

†Measured in fathers at age 18.

‡Measured as parental hospitalizations before offspring's 12<sup>th</sup> birthday.

## Fathers' alcohol use and offspring suicidal behaviour

Table 4. Crude and adjusted Cox regression models of the association between different indicators of fathers' alcohol consumption and suicidal behaviour in offspring, 1982–2008. Hazard ratios (HRs) with 95% confidence intervals (95% CI). All models adjusted for offspring sex and year of birth

Fathers' alcohol use	Model 1 Crude			Model 2 Childhood SEP			Model 3 Fathers' risk factors at conscription*			Model 4 Parental mental disorders†			Model 5 Fully adjusted		
	HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI	
Volume of consumption‡															
Abstainers (ref)	1.00			1.00			1.00			1.00			1.00		
1	1.15	0.83	1.60	1.12	0.80	1.55	1.18	0.85	1.64	1.13	0.81	1.58	1.14	0.82	1.58
2	1.19	0.85	1.65	1.15	0.83	1.60	1.22	0.88	1.70	1.17	0.84	1.63	1.18	0.85	1.64
3	1.31	0.94	1.82	1.27	0.91	1.77	1.35	0.97	1.87	1.26	0.91	1.75	1.28	0.92	1.77
4	1.37	0.97	1.89	1.29	0.93	1.79	1.38	1.00	1.91	1.30	0.94	1.80	1.27	0.92	1.76
5	1.83	1.33	2.52	1.63	1.18	2.24	1.67	1.21	2.30	1.60	1.16	2.20	1.40	1.02	1.93
Freq. of intoxication															
Abstainers (ref)	1.00			1.00			1.00			1.00			1.00		
Drinkers never intox.	1.10	0.77	1.56	1.08	0.75	1.54	1.11	0.77	1.59	1.07	0.75	1.53	1.08	0.76	1.55
Sometimes	1.38	1.02	1.87	1.31	0.97	1.78	1.40	1.04	1.90	1.32	0.97	1.79	1.30	0.96	1.76
Quite often	1.47	1.05	2.06	1.33	0.95	1.87	1.36	0.97	1.91	1.33	0.95	1.86	1.19	0.85	1.67
Often	2.06	1.27	3.35	1.72	1.06	2.80	1.55	0.95	2.54	1.54	0.92	2.55	1.14	0.68	1.90
Appreh. for drunkenness															
Abstainers (ref)	1.00			1.00			1.00			1.00			1.00		
Drinkers never appreh.	1.27	0.94	1.72	1.22	0.90	1.65	1.28	0.95	1.74	1.24	0.91	1.67	1.22	0.90	1.65
Apprehended once	1.93	1.35	2.77	1.68	1.17	2.41	1.79	1.24	2.57	1.66	1.15	2.38	1.45	1.01	2.09
Apprehended ≥ twice	4.20	2.86	6.17	3.18	2.16	4.66	3.18	2.14	4.73	2.93	1.97	4.35	2.10	1.40	3.14
Alcohol-rel. disorders															
Abstainers (ref)	1.00			1.00			1.00			1.00			1.00		
No alcohol-rel. disorder	1.29	0.96	1.75	1.24	0.91	1.67	1.30	0.96	1.76	1.26	0.93	1.71	1.23	0.91	1.66
Alcohol-related disorder	4.47	3.11	6.43	3.22	2.23	4.65	3.75	2.59	5.41	2.43	1.61	3.67	1.90	1.27	2.85

\*Emotional control and psychiatric diagnosis;

†Parental hospitalizations due to: suicide attempts, alcohol-related disorders (models of father alcohol-related disorders only adjusted for mothers alcohol disorders), drug-related disorders or common mental disorders.

‡Volume quintiles + abstainers

Adjustment for childhood SEP only slightly attenuated the HRs, suggesting that the associations are not significantly confounded by this factor. Similarly, separate adjustment for the remaining covariates only attenuated the HRs marginally. Still, concurrent adjustment for all covariates (in the fully adjusted model) resulted in more substantial attenuations. For the volume indicator, the HR for the highest consumption quintile was attenuated slightly more than half, to 1.40 (95% CI 1.02, 1.93). Similar attenuations in the risk for suicidal behaviour were obtained for the groups of offspring with fathers who had been apprehended for drunkenness once (1.45 [95% CI 1.01, 2.09]), or two times or more (2.1 [95% CI 1.4, 3.14]), or with an alcohol-related disorder (1.9 [95% CI 1.27, 2.85]). Conversely, the HRs for drinking into intoxication were essentially fully attenuated and no longer significant.

To assess whether offspring to fathers drinking heavily, but without clinically diagnosed alcohol disorders, also are of increased risk for suicidal behaviour, we replicated the fully adjusted models after exclusion of fathers with alcohol-related diagnoses. This did not affect the estimates for the highest categories of volume of consumption and being apprehended for drunkenness, and resulted

in HRs of 1.44 (95% CI 1.04, 1.99) and 2.08 (95% CI 1.33, 3.24) respectively.

### Sensitivity analysis

Table 5 shows the sensitivity analysis with the interaction of parental alcohol diagnosis as exposure variable. Having a father with an alcohol-related diagnosis was associated with a three-fold risk of suicidal behaviour relative to offspring without parental alcohol diagnoses, whereas offspring to mothers with alcohol-related diagnoses had a more than four-fold increase in risk. The largest risk, with an HR of 13.73 (95% CI 8.31, 22.68), was found for offspring who had both a mother and a father with alcohol-related diagnosis. Moreover, as in previous models, adjustment for childhood SEP and the risk factors measured at conscription resulted in smaller attenuations. Adjustment for parental mental disorders, on the other hand, led to more substantial attenuations, especially for offspring who had mothers or both parents with alcohol-related diagnoses, where the HRs decreased by more than half.

Second, we estimated models with suicide attempts as outcome (Table S2). Although the effect size of the HRs generally was somewhat

Table 5. Crude and adjusted Cox regression models of the association between hospitalizations due to parental alcohol-related disorders and suicidal behaviour in offspring, 1982–2008. Hazard ratios (HRs) with 95% confidence intervals (95% CI)

	Model 1 Crude		Model 2 Childhood SEP			Model 3 Fathers' risk factors at conscription*			Model 4 Parental mental disorders†			Model 5 Fully adjusted	
	HR	95% CI	HR*	95% CI		HR	95% CI	HR	95% CI	HR	95% CI		
Parental alcohol-related disorders													
No alc.-rel. disorder (ref)	1.00		1.00			1.00		1.00		1.00			
Mother alc.-rel. disorder	4.19	2.60 6.74	3.52	2.18 5.69		3.91	2.44 6.27	1.80	1.02 3.19	1.71	0.98 2.97		
Father alc.-rel. disorder	3.09	2.43 3.93	2.34	1.82 2.99		2.59	2.02 3.31	1.92	1.41 2.59	1.51	1.17 2.02		
Both alc.-rel. disorder	13.73	8.31 22.68	10.05	6.05 16.67		11.51	6.84 19.37	4.76	2.48 9.12	4.09	2.01 7.83		

\*Emotional control and psychiatric diagnosis.

†Hospitalizations due to: suicide attempts, drug-related disorders or common mental disorders

smaller in these analyses, the results did not materially change the findings of our main analyses.

Third, we fitted models that included adjustment for alcohol-related hospitalizations in offspring (Table S3). While this resulted in attenuations of 30 to 50% compared to the crude models, the HRs remained positive and significant, implying that the relationships only partly are mediated by offspring heavy drinking. In addition, we fitted models that included offspring with alcohol-related hospitalizations occurring also after suicide attempts, which produced similar results.

Finally, we replicated the fully adjusted models after exclusion of offspring with divorced fathers (Table S4). This resulted in estimates that were similar to our main analyses. It should be noted that the HR for the highest volume quintile became just close to significant ( $P = 0.061$ ). Still, considering that the magnitude of the HR remained basically unchanged, 1.38 (0.99, 1.93), we interpret this finding as being a result of decreased power (due to the exclusion of a large number of offspring in the analyses), rather than a sign of reduction of the strength of the association at issue.

## Discussion

This study investigates how different dimensions of parental drinking are related to risk of suicidal behaviour in offspring during youth and young adulthood. All studied indicators of fathers' alcohol use showed a positive and significant relation with increased risk of suicidal behaviour in offspring. The highest risks were found for offspring to fathers with the most problematic consumption, that is having been apprehended for drunkenness more than once, or with a diagnosed alcohol-related disorder. However, our findings revealed that offspring to fathers drinking heavily, but without diagnosed alcohol-related disorders, also are of increased risk for suicidal behaviour. Moreover,

although the associations to a large extent were explained by other risk factors for suicidal behaviour in offspring that tend to co-occur with parental heavy drinking, most indicators of fathers' alcohol use were still independently associated with later suicidal behaviour in offspring in the fully adjusted models.

Consequently, our results add support to the literature showing that parental drinking, also at levels below clinically diagnosed alcohol problems, is associated with suicidal behaviour in offspring (8, 12). However, unlike Rossow and Moan (8), who found already lower frequencies of parental intoxication to be associated with suicidal behaviour in offspring, we could only establish significant associations for the heaviest categories of fathers' self-reported consumption. The discrepancy in results may be explained by that Rossow and Moan fail to control for possible confounders that were included in the present study, for example parental mental disorders. In fact, while all categories of fathers' frequency of intoxication were significant also in our crude models, the estimates were in principle fully attenuated after concurrent adjustment of all covariates. Still, the present findings are in line with our previous study showing that the long-term risk of suicide only was elevated among sons who reported the highest frequency of fathers' consumption (13).

With regard to pathways and mechanism linking parental drinking to suicidal behaviour in offspring, we found that a substantial proportion of the association between fathers' alcohol use and offspring suicidal behaviour was explained by other risk factors that tend to cluster with parental heavy drinking. Yet, unlike our previous study, where the association between frequency of fathers' drinking and long-term risk for suicide in sons was fully explained after adjustment for other explanatory factors, most alcohol use indicators in the present study were independently associated with later suicidal behaviour in offspring, also after



concurrent adjustment for covariates. On the one hand, this finding may be due to methodological differences; for example, the measures of fathers alcohol use were self-reported in the present study, while it was reported by the offspring in the former. On the other, if it reflects actual differences in the strength of the association, it may indicate that fathers' alcohol use has a stronger effect on suicidal behaviour among offspring in youth and young adulthood than on long-term risk of completed suicides. Moreover, while the covariates included in the present study most likely are confounders for the association at issue, some of them are measured later in time than the indicators of fathers' alcohol consumption and may hence lie on the causal pathway between fathers' drinking and offspring suicidal behaviour. For instance, it is possible that low childhood SEP or fathers' hospitalizations due to mental disorders were influenced by fathers' heavy drinking. In this case, it would be more correct to view the covariates as mediators, implying that our adjusted risk estimates might underestimate the true associations. Finally, our sensitivity analysis showed that alcohol-related disorders in offspring accounted for a substantial part of the associations between fathers alcohol use and offspring suicidal behaviour, thus indicating that the association partly is due to a direct transmission of heavy drinking from fathers to offspring.

### Strengths and limitations

Our study improves on previous literature by analysing a range of indicators of parental alcohol use, by adjusting for other risk factors of suicidal behaviour in offspring that tend to cluster with parental heavy drinking, and by using unique data that combine survey information from a full cohort of Swedish men (fathers), with information from national registers for a long-term follow-up of suicidal behaviour in their offspring. Some limitations of the study should also be noted. First, the self-reported indicators of fathers' alcohol use were measured in fathers' youth. Considering that alcohol use tends to vary across the life-course, and in particular around life-events such as parenthood (33, 34), the variables do not measure actual exposure to parental drinking during the offspring childhood, but rather whether fathers' alcohol use in youth translates into risk for suicide in offspring. In relation to this, the finding that only the heaviest alcohol use categories are associated with suicidal behaviour in offspring may reflect a higher degree of misclassification in the lower consumption categories. On the other hand, measuring the consumption at an earlier time point than offspring's childhood may help

isolate the causal effect of fathers' alcohol use, since it would be less confounded by other risk factors for suicidal behaviour in offspring that tend to cluster with parental heavy drinking during childhood. Second, we had no self-reported information on maternal alcohol use. The sensitivity analyses revealed that maternal alcohol-related hospitalizations were associated with a somewhat larger risk for offspring suicidal behaviour compared having a father with an alcohol-related hospitalization. Thus, indicating that alcohol use among mothers also is associated with risk for later suicidal behaviour in offspring. Lastly, we did not have information on whether the offspring actually lived with their fathers while growing up. Fathers with alcohol use disorders might be more likely to divorce, thereby potentially weakening the link between their alcohol use and offspring suicidal behaviour – implying that our HRs to some extent underestimate the true associations. However, our sensitivity analyses excluding offspring with divorced fathers resulted in estimates similar to our main analyses, thus indicating that this is not a serious issue in the current sample.

### Policy implications

Our findings revealed that offspring to fathers with alcohol-related clinical diagnoses had the highest risk of suicidal behaviour. Yet, the small size of this group implied that it only accounted for 7% ( $n = 86$ ) of all cases of suicidal behaviour in offspring, whereas a larger proportion, 20% ( $n = 258$ ), occurred among offspring of fathers drinking heavily (i.e. in the highest volume quintile), but without clinically diagnosed alcohol-related problems. Consequently, in addition to prevention efforts aimed at children of parents with diagnosed alcohol-related disorders, our findings stress the importance of applying a broader public health approach in order to prevent the majority of suicidal behaviour in offspring owing to parental heavy drinking. In particular, universal alcohol policy measures targeting price and availability of alcohol tend to be effective for reducing the prevalence of heavy drinking in a population (35).

### Conclusions

Fathers' alcohol use is associated with increased risk of suicidal behaviour among offspring in youth and young adulthood. The highest risk is found for offspring to fathers with the most problematic consumption, including being apprehended for drunkenness and diagnosed alcohol-related disorders. However, our findings reveal that offspring

to fathers drinking below these levels also are of increased risk for suicidal behaviour. Moreover, although the associations to a large extent are explained by other risk factors that tend to co-occur with parental heavy drinking, most indicators of fathers' alcohol use are independently associated with increased risk of suicidal behaviour in offspring.

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### Declarations of interest

None.

### Author contributions

Landberg, J conceptualized the study, conducted the data analysis and interpreted the data, drafted the article, and approved the final version. Hemmingsson, T conceptualized the study, acquired the data, participated in the data analysis and in the interpretation of data, revised the article, and approved the final version. Danielsson, AK conceptualized the study, acquired the data, participated in the interpretation of data, revised the article, and approved the final version.

### Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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### Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Table S1.** Correlation Matrix (Spearman's rho) including the indicators of fathers' alcohol use.

**Table S2.** Crude and adjusted Cox regression models of the association between different indicators of fathers' alcohol consumption and suicide attempts in offspring.

**Table S3.** Cox regression models of the association between different indicators of fathers' alcohol consumption and suicidal behaviour in offspring, adjusted for alcohol-related hospitalisations in offspring.

**Table S4.** Cox regression models of the association between different indicators of fathers' alcohol consumption and suicidal behaviour in offspring, excluding offspring with fathers that were divorced in 1985.